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Optimal frequency for flow energy harvesting using flapping foils and its relation with wake instability QIANG ZHU, UC San Diego — Inspired by the correlation between the propulsion efficiency of a flapping foil propeller and stability of the wake behind it (which leads to the optimal Strouhal number for propulsion), we numerically simulated a foil in energy harvesting mode, and investigated the relation between wake stability and the energy harvesting efficiency (defined as the portion of incoming flow energy extracted by the system). The base flow is computed using a Navier-Stokes algorithm and the flow stability analysis is performed numerically via the Orr-Sommerfield equation. The wake is found to be convectively unstable and the frequency of the most (spatially) unstable mode fw is determined. The optimal efficiency occurs when fw is close to f (the oscillation frequency of the foil), which is achieved when f is close to 0.15 (hereby f is normalized by the chord length and the speed of incoming flow). In addition, for this "foil-wake resonance" to happen there must be significant leading edge separation associated with large effective angles of attack.

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